US005314403A

United States Patent [19]

Shaw

[11] Patent Number: 5,314,403

[45] Date of Patent: May 24, 1994

[54] **APPARATUS FOR THE ENHANCEMENT OF THE ENJOYMENT OF THE EXTREMELY LOW FREQUENCY COMPONENT OF MUSIC**

[76] Inventor: **Richard T. Shaw**, 13003 SE. Hwy. 212, Clackamas, Oreg. 97015

[21] Appl. No.: **995,185**

[22] Filed: **Dec. 22, 1992**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 824,069, Apr. 24, 1992, abandoned.

[51] **Int. Cl.**[5] **A61H 1/00**

[52] **U.S. Cl.** **601/148**; 297/217; 5/916; 5/933; 601/57; 601/55

[58] **Field of Search** 128/33, 64, 65, 32; 5/449, 451, 455, 654, 904, 915, 916, 933; 297/454, 455, 452, 217

[56] **References Cited**

U.S. PATENT DOCUMENTS

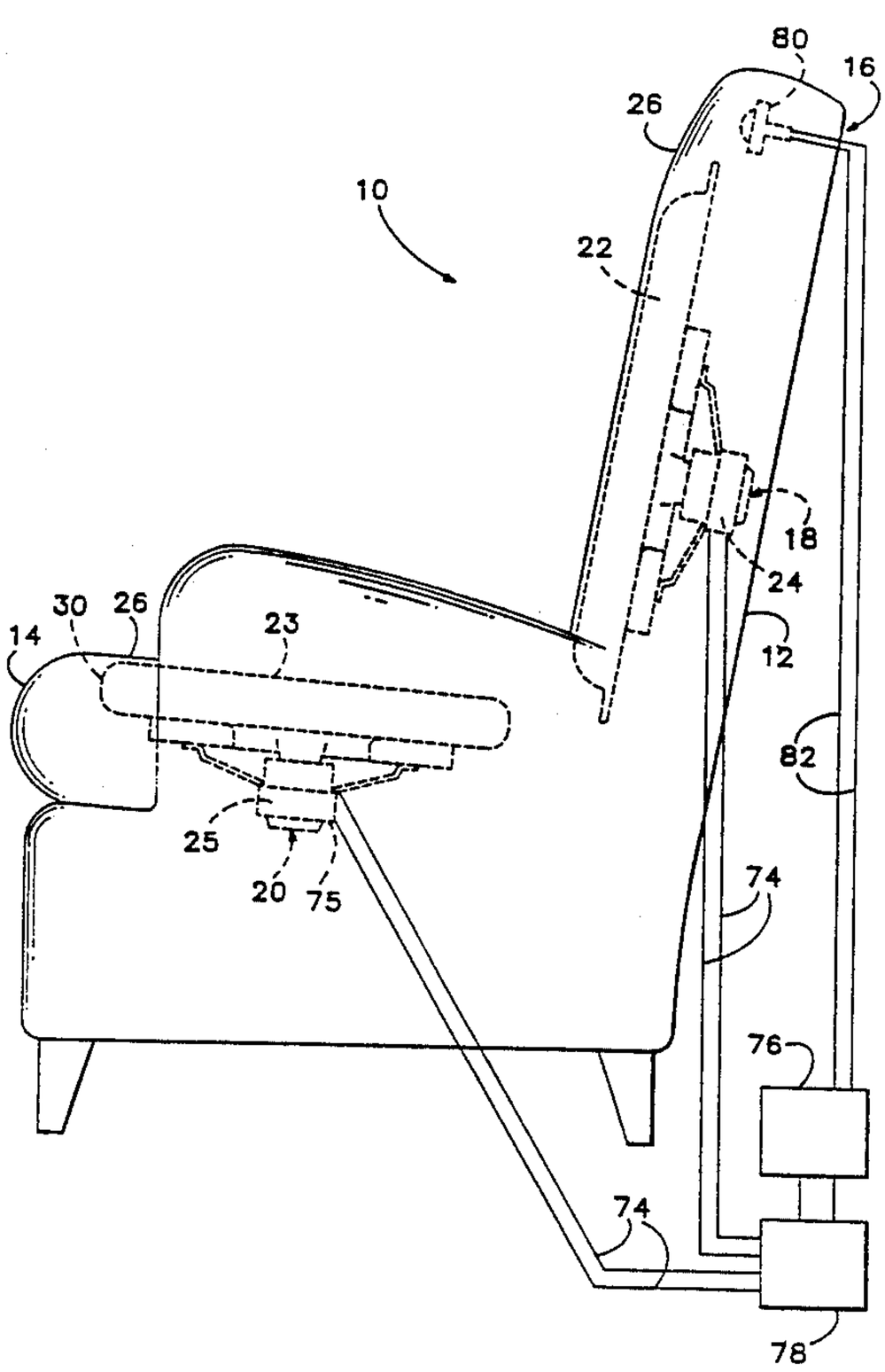
2,821,191	1/1958	Paii	128/33
3,880,152	4/1975	Nohmura	128/33
4,023,566	5/1977	Martinmass	128/33
4,189,181	2/1980	Noble et al.	297/455
4,391,466	7/1983	Smith	297/452
4,507,816	4/1985	Smith, Jr.	5/451
4,538,596	9/1985	Colasante	128/32
4,757,548	7/1988	Fenner	128/33
4,929,026	5/1990	Barbelet	257/454
5,076,260	12/1991	Komatsu	128/33
5,086,755	2/1992	Schmid-Eilber	128/33
5,097,821	3/1992	Eakin	128/33
5,101,810	4/1992	Skille	128/33
5,113,852	5/1992	Murtonen	128/33

Primary Examiner—Robert A. Hafer
Assistant Examiner—David J. Kenealy
Attorney, Agent, or Firm—Chernoff, Vilhauer, McClung & Stenzel

[57] **ABSTRACT**

A device for enhancing enjoyment of electronically reproduced music including a chair with liquid-filled bladders coupled to transducers such as electromagnetic driver assemblies responsive to audio-frequency electrical signals. A diaphragm of elastic sheet material provides support for part of the bladder and part of the transducer. Bladders and transducers are located in the seat and back of the chair, and the transducers move the liquid in the bladders, so that movement of the liquid can be felt by a user sitting in the chair. The electrical signals are preferably filtered to pass only bass frequencies to the transducers.

10 Claims, 8 Drawing Sheets



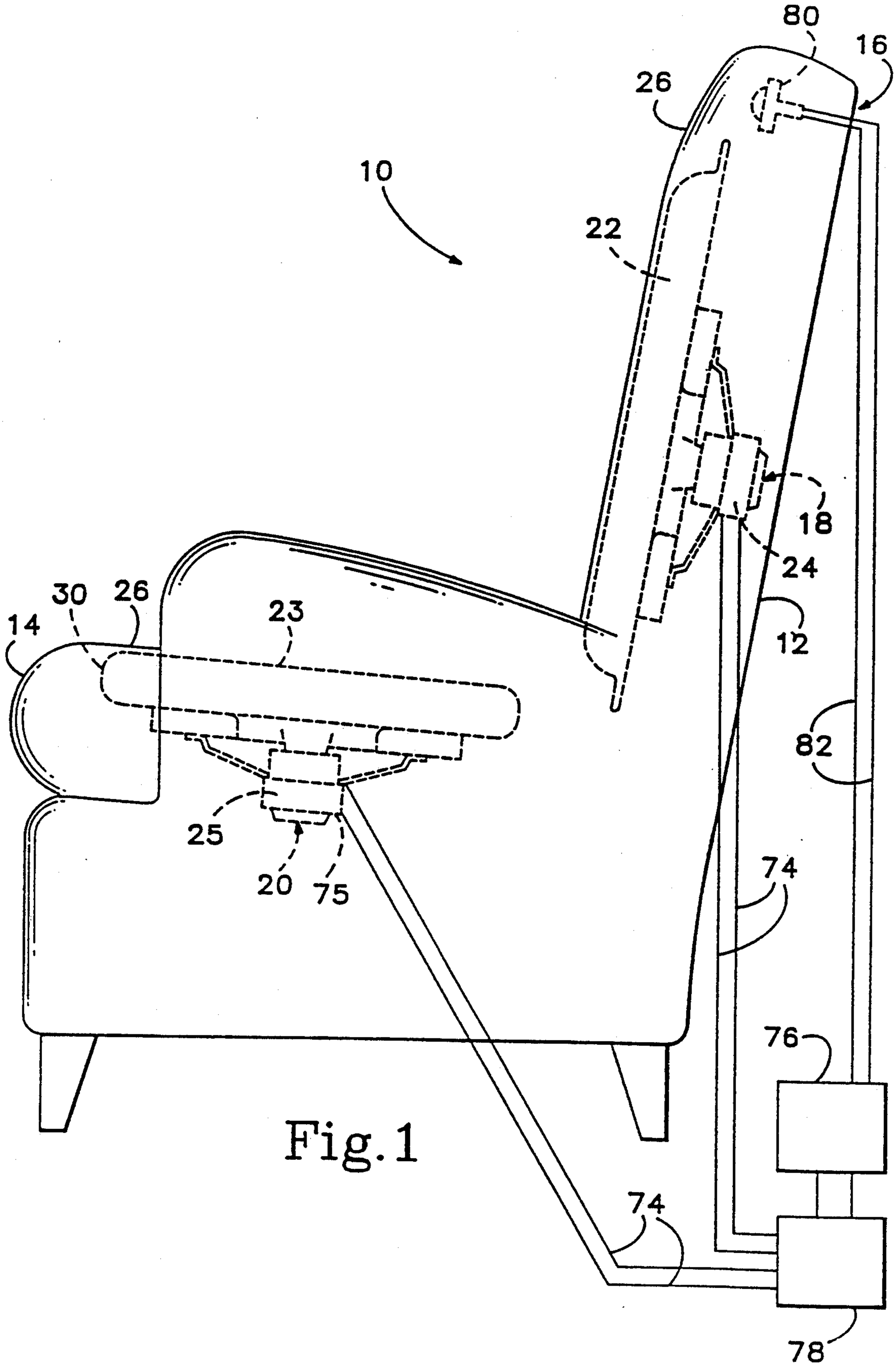


Fig. 1

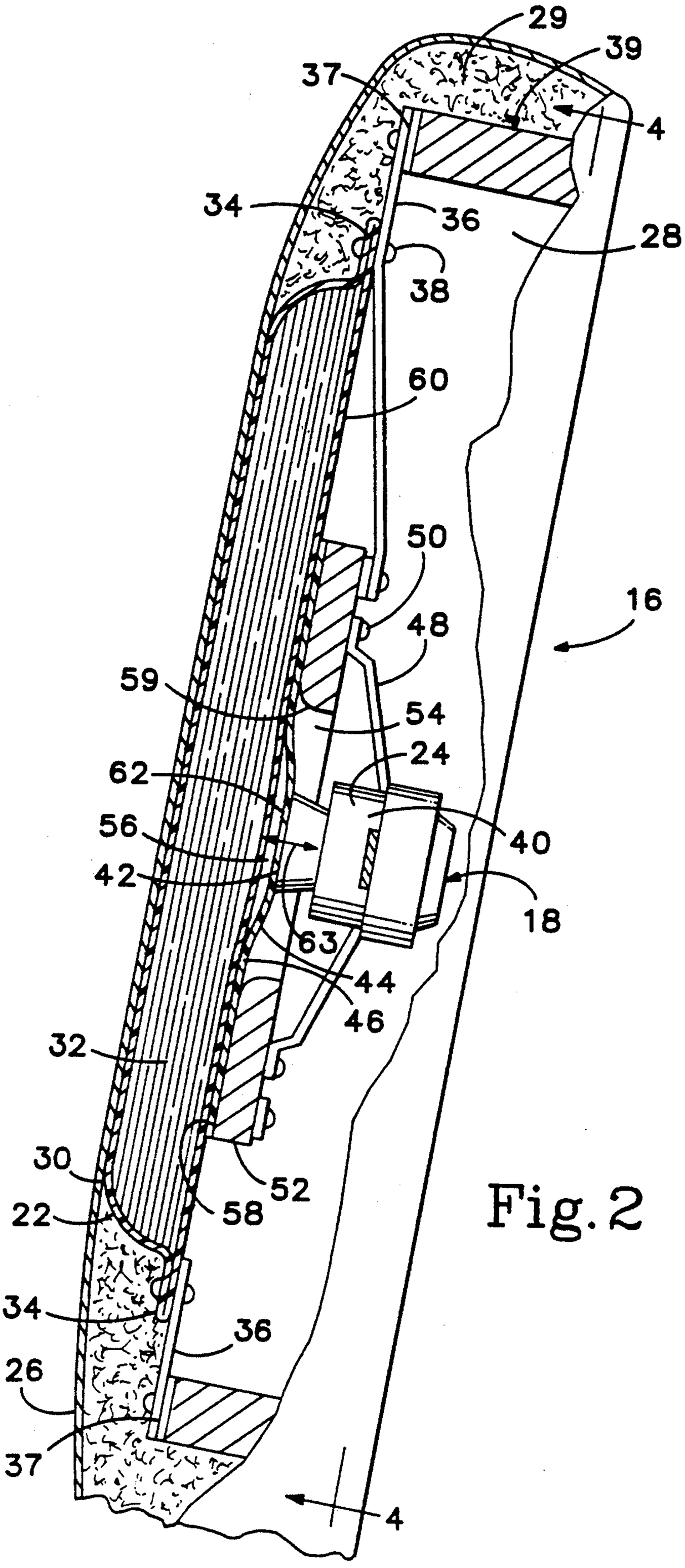

29
39
37
4
34
36
28
38
60
50
16
48
59
54
24
62
56
40
42
18
63
44
46
32
30
52
22
58
34
36
26
37
4

Fig. 2

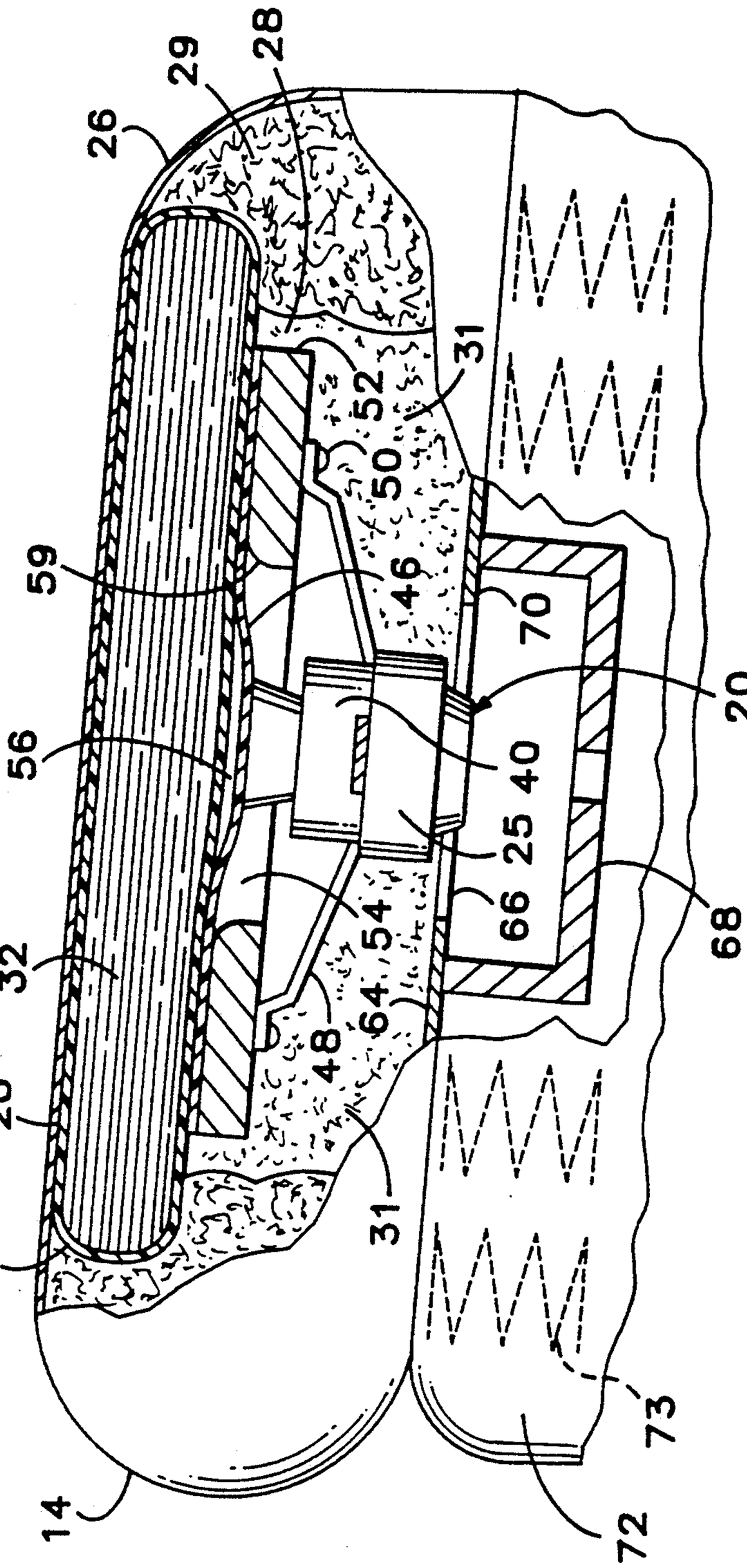

29
28
26
31
52
50
59
46
70
20
56
40
25
66
68
54
64
48
32
23
30
31
14
72
73

Fig. 3

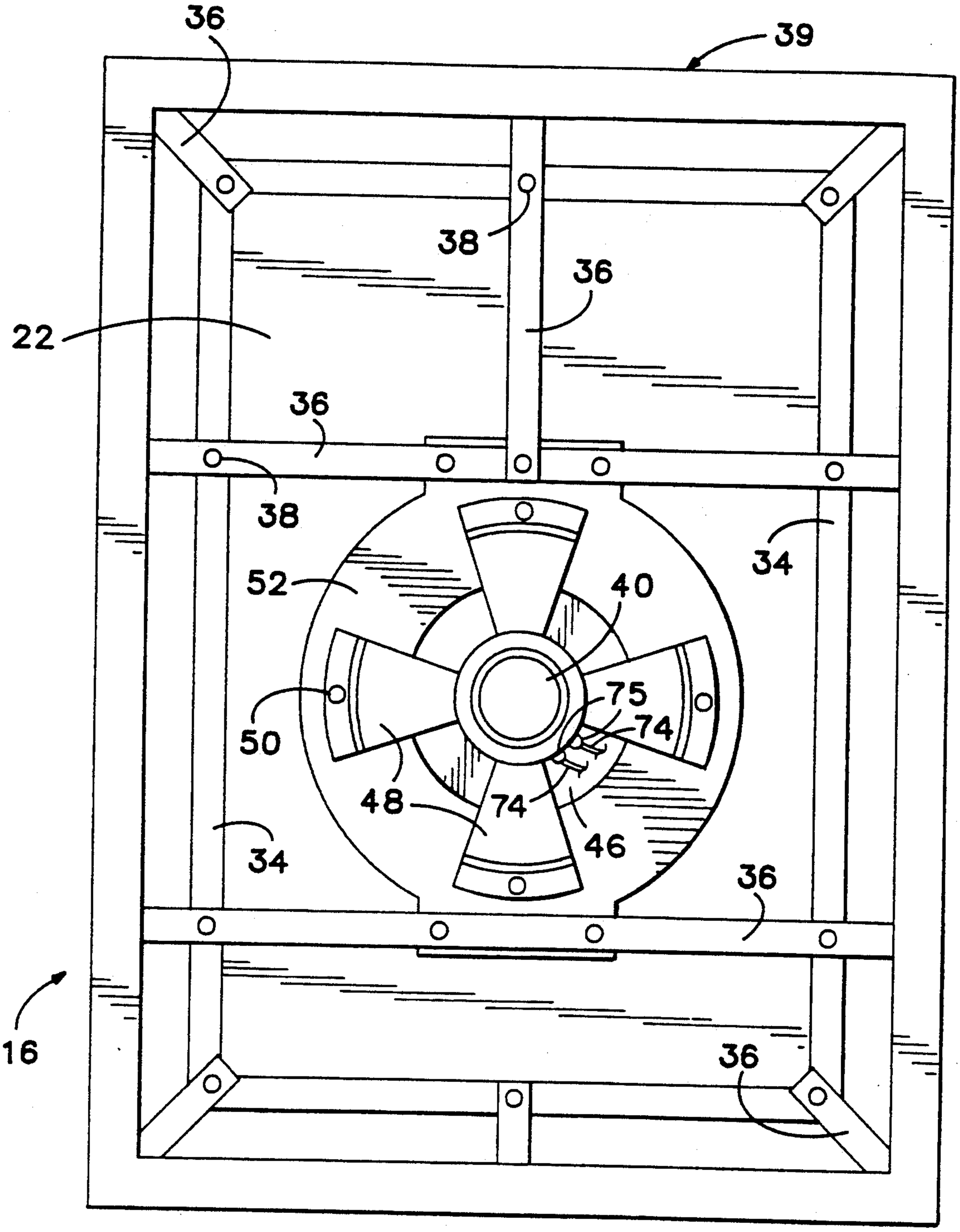


Fig. 4

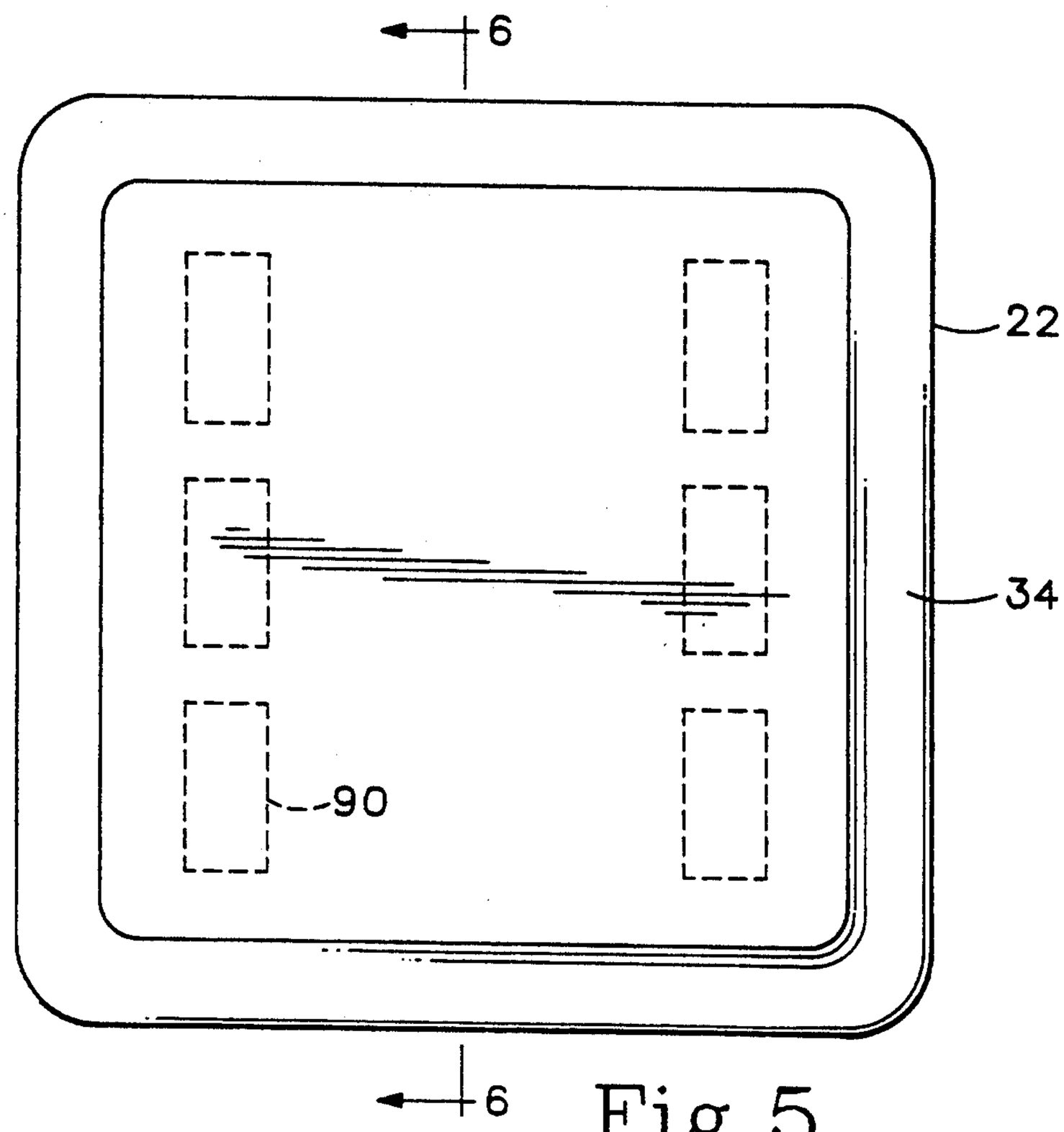


Fig. 5

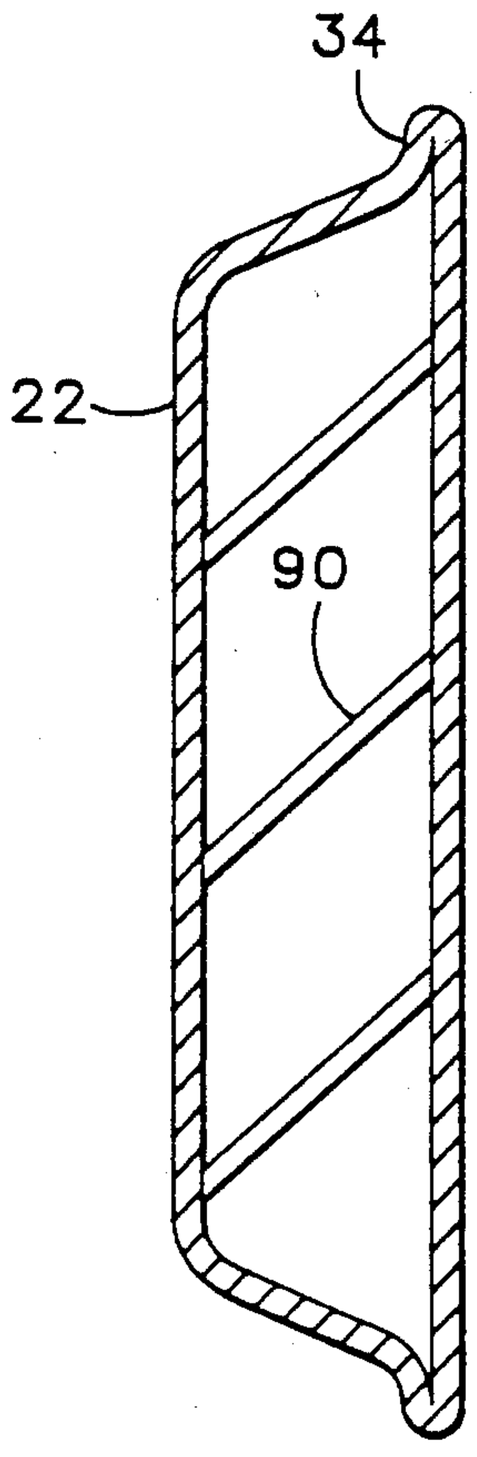


Fig. 6

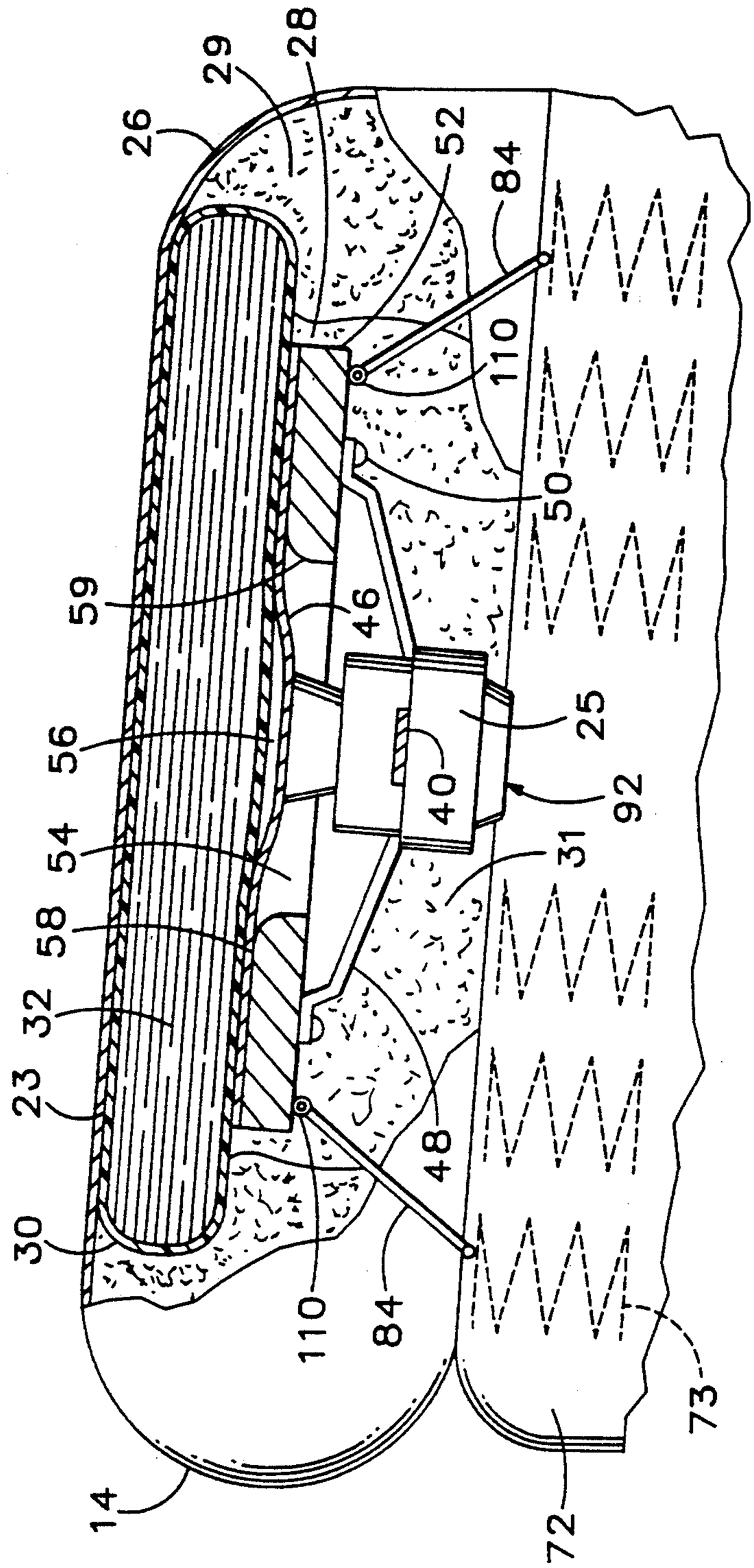

29
28
26
52
84
110
50
59
46
56
25
40
92
54
31
58
32
23
48
30
110
84
14
72
73

Fig. 7

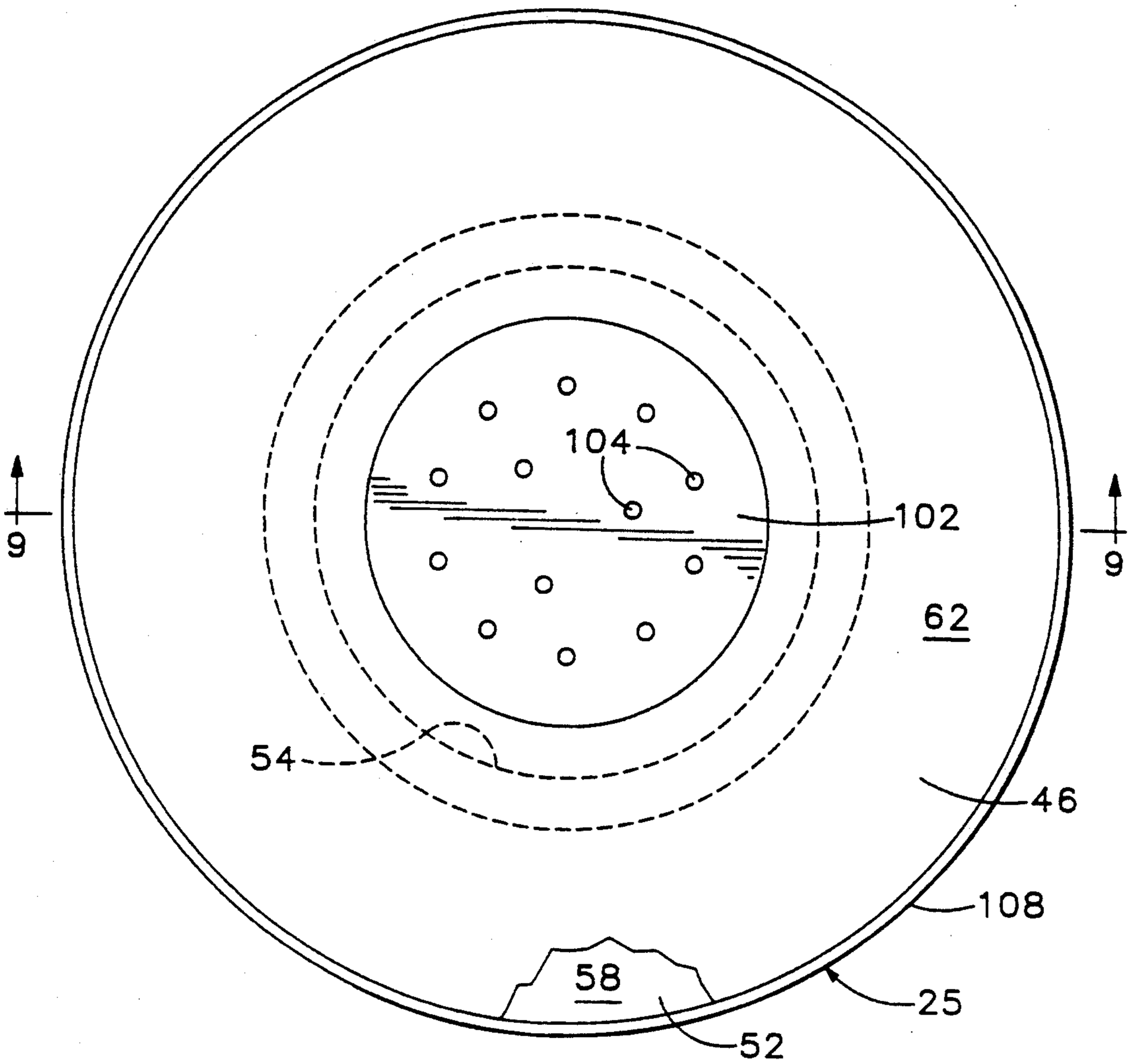

104
102
9
9
62
54
46
108
58
25
52

Fig. 8

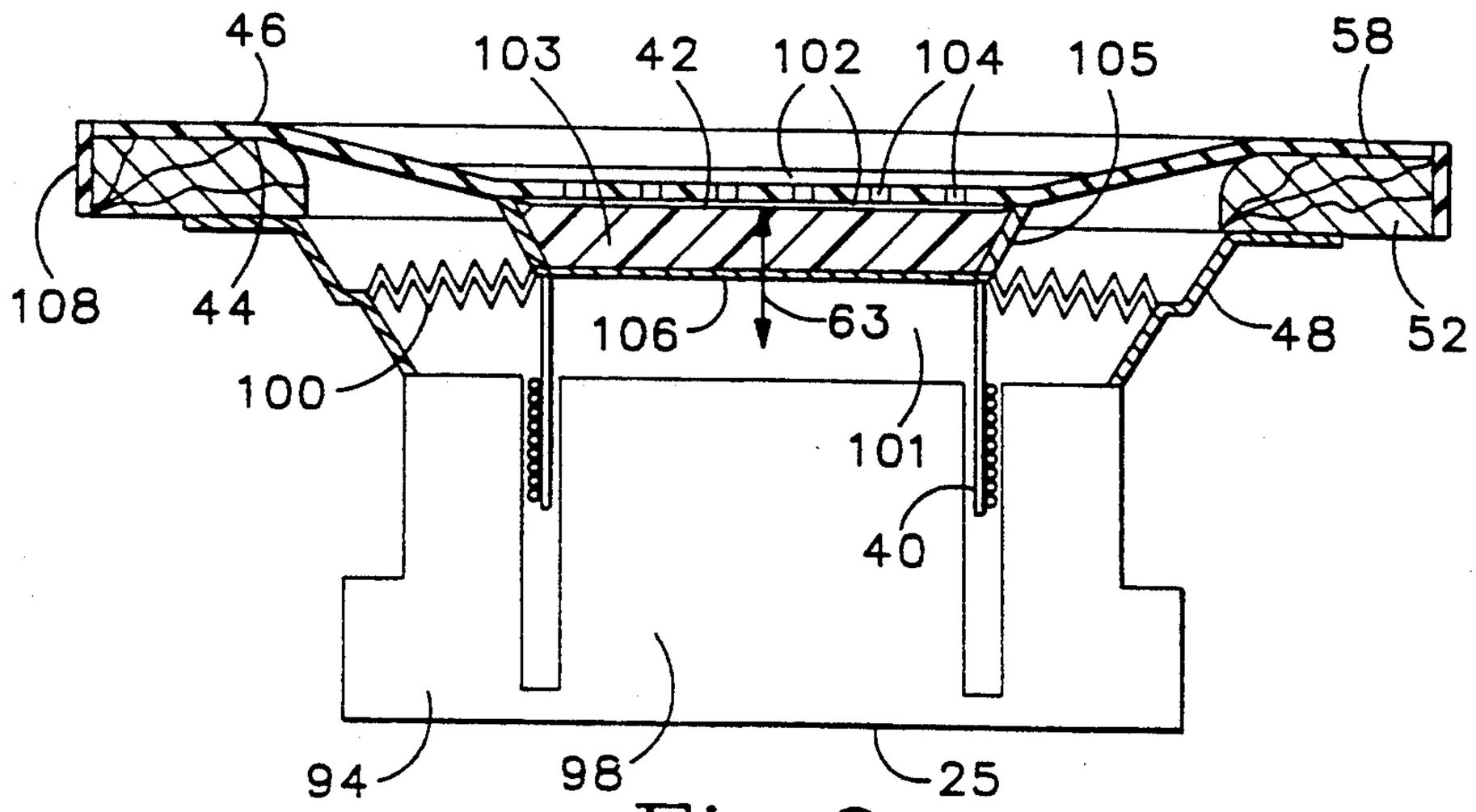

46
103
42
102
104
105
58
108
44
106
63
48
52
100
101
40
94
98
25

Fig. 9

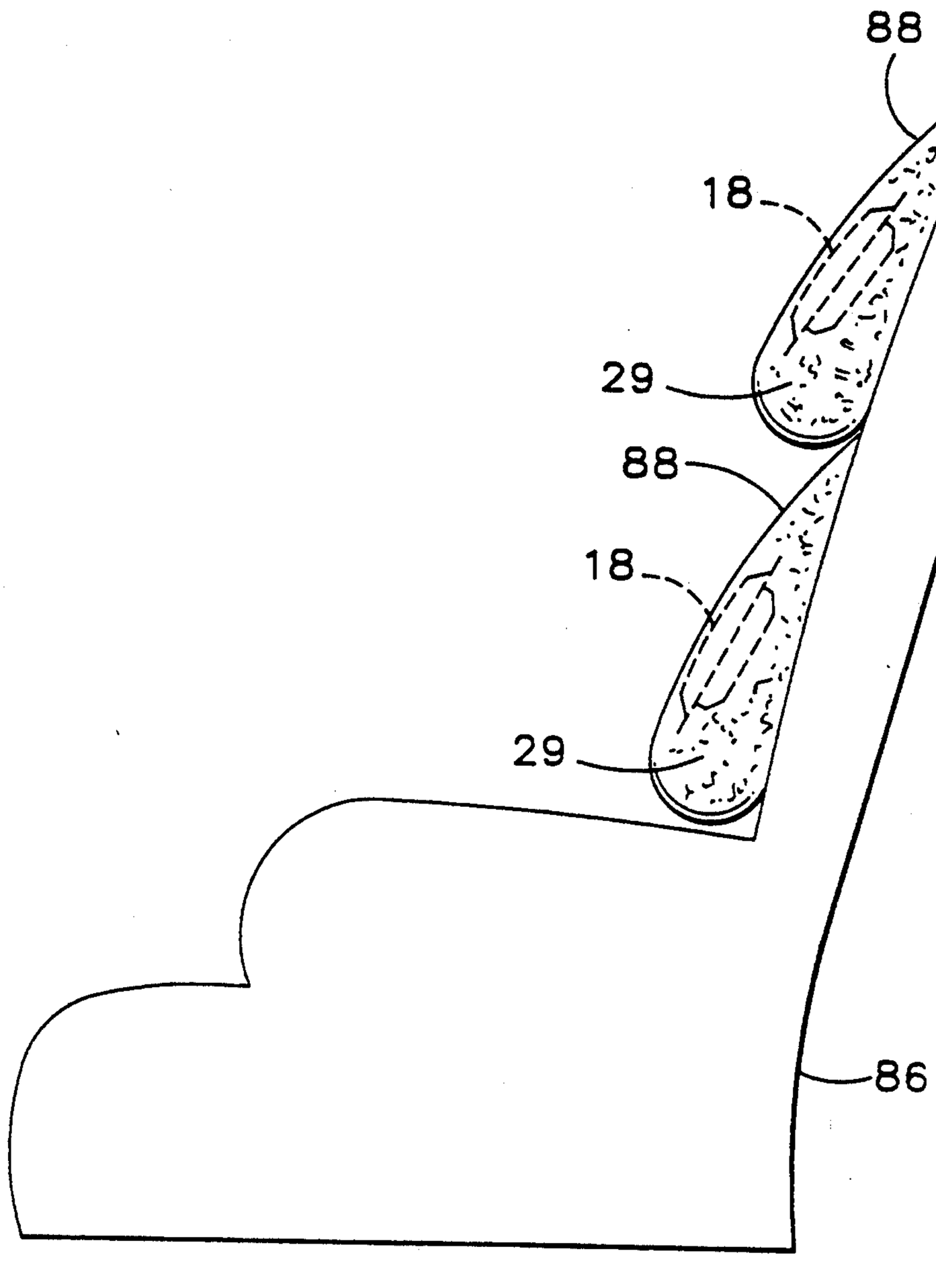


Fig.10

APPARATUS FOR THE ENHANCEMENT OF THE ENJOYMENT OF THE EXTREMELY LOW FREQUENCY COMPONENT OF MUSIC

This application is a continuation-in-part of copending patent application No. 07/874,069, filed Apr. 24, 1992, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to devices and methods for enhancing enjoyment of electronically reproduced music.

Advances in audio technology have resulted in systems capable of quite accurately reproducing music over the entire range of audibility (approximately 12–20,000 Hertz). A multitude of individual audio components are available that may be combined to reproduce music having very little distortion of the input audio signal. These audio systems are also capable of producing sounds at a very high amplitude.

The enjoyment of listening to music is not limited to auditory perception, but in addition, it includes the receiving of the acoustic vibrations of music through the body. The human body "feels" vibrations primarily in the extremely low frequency (hereinafter ELF or bass), range of less than 250 Hertz. Unfortunately, in order to generate a bass level of sound that is enjoyable in this manner, it is often necessary to turn the volume level of the system up to a very high level. The result may be a volume that may injure the ears of people in close proximity or disturb people in adjacent areas. Quite often bass levels that are sufficiently loud to be enjoyed by intended listeners are transmitted through walls and ceilings, disturbing the unintended. Alternatively, the audio system controls may be adjusted to provided more bass and/or less treble, but this results in a distorted output.

Paii U.S. Pat. No. 2,821,191 discloses a pulsating device, in particular, a treatment table wherein pulsations produced are controlled somewhat in proportion to the volume of sound waves emanating from a loudspeaker. In Paii, the variations in vibration from a speaker are used to control the current delivered to a pulsator motor. Connected to the output shaft of the pulsator motor are eccentrics. It is the movements of these eccentrics that create the vibrations perceived by the user of the device.

Nohmura U.S. Pat. No. 3,880,151 discloses a health promoting device comprising a chair or a bed with loudspeakers incorporated within to generate rhythmical vibrations. The sounds generated by the loudspeakers are propagated through an air space between the speakers and the surface of the chair or bed before they reach the person resting upon the chair or the bed.

Martinmaas U.S. Pat. No. 4,023,566 discloses the use of loudspeakers in either chairs or beds, where the speakers are mounted in chambers filled with air facing the body support structure. The speakers produce vibrations within the chamber which are propagated through the air within the chamber to reach and be heard before they are felt by the occupant.

Smith U.S. Pat. No. 4,507,816 discloses a sound wave system for use with a water bed where sounds from loudspeakers located in individual airtight speaker enclosures are directed upwardly through the air within the speaker enclosure into the water-filled mattress to create water waves and vibrations that are synchronized with the sound.

All of the above-described devices have the goal of producing vibrations that are representative of the full range of frequencies contained in the source music. With the exception of the Paii device, all of the prior apparatus relies upon the transmission of sound waves through air prior to being absorbed into the body.

Because sound waves spread widely in air, especially at lower frequencies, it is difficult to create pleasant bass vibrations which can be felt within a human body, using air to transmit the sound, without disturbing people who do not want to hear the sound.

What is needed, therefore, is an improved apparatus that will allow the user to listen to a properly balanced audio output at a reasonable volume while enjoying feeling the bass vibrations.

SUMMARY OF THE INVENTION

The present invention answers the aforementioned need by providing an apparatus that allows the user to listen to a properly balanced audio output at a reasonable volume while also feeling vibrations created by the bass frequencies of the audio output. An apparatus for applying vibrations to a portion of a human body according to the present invention includes a transducer efficiently coupled to a flexible bladder substantially full of a liquid. An electrical signal drives the transducer, and the transducer creates vibrations within the liquid-filled bladder. When a portion of a human body contacts the bladder, the vibrations within the bladder are transmitted to that portion of the human body.

In a preferred embodiment of the invention, the apparatus includes a chair to seat the user. Cavities within the seat and back of the chair contain transducers and bladders. The flexible yet preferably inelastic liquid-filled bladder presses firmly against the covering of the back or seat of the chair. The transducer is supported in a position adjacent the bladder and is coupled intimately with the bladder in order to move the bladder efficiently, thus moving its liquid contents and a person's body supported by the bladder. Pressed firmly against the back side of the bladder is a resiliently elastic diaphragm which is attached to the front side of a mounting board which defines an opening through its center.

Attached to the back side of the mounting board is the transducer, which in a preferred embodiment of the invention resembles a loudspeaker that has been modified. The modified loudspeaker has only the electromagnetic driver assembly and part of the metal cone support frame of the original structure. Legs formed from the metal cone support frame firmly attach the modified audio loudspeaker to the back side of the mounting board. The electromagnetic driver assembly is centered within the opening in the mounting board and the face of the driver assembly is adhesively attached to the back side of the diaphragm so that the diaphragm provides a resilient mechanical suspension for the driver assembly.

In one embodiment of the transducer according to the invention the diaphragm is attached to the mounting board, and tightly stretched across the opening. The diaphragm provides support for the bladder and a person resting on the bladder and also supports the electromagnetic driver assembly, providing an elastic bias to support the driver assembly in a position where it will still be able to move in either direction when a person's weight is resting on the associated bladder.

An electrical signal, preferably in the ELF range, is applied to the driver assembly, which produces motion of the driver's face in response. Movements of the driver's face move the adjacent surface of the liquid-filled bladder, creating vibrations which are transmitted efficiently through the liquid to be felt by the portion of a human body contacting the portion of the chair above the transducer assembly.

It is contemplated that transducers other than modified loudspeakers will function quite adequately to create vibrations within the bladder. For example, other forms of electromagnetic components such as solenoids could be used as transducers. It is also possible that pneumatically driven transducers could be used.

It is contemplated that the source of the electrical signal to drive the transducer would be an audio electronics component such as a radio receiver or an amplifier and that the signal would be filtered by a graphic equalizer or other filter to include only ELF. It is also possible that other electronic signal sources or frequencies other than ELF could be used. Such devices as pulse generators, tone generators or even amplified electronic music instruments could provide acceptable electrical signals.

The present invention is more effective than prior inventions in providing vibrations related to the bass portions of music in a way in which they can be felt in a person's body. Unlike prior inventions that have used mechanical devices not controlled by music to create vibrations or that have propagated vibrations through air en route to the desired portion of a human body, in the present invention, vibrations are transmitted directly to and through the liquid-filled bladder and then into the human body. A liquid-filled bladder more closely resembles the composition of the human body than does an air-filled bladder, and accomplishes a more efficient transfer of vibrations and less attenuation of the vibrations.

It is therefore a principal object of the present invention to provide an improved apparatus for applying vibrations to a portion of a human body.

The foregoing and other objectives, features and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a chair embodying the invention.

FIG. **2** is a partially cutaway view of the back of the chair shown in FIG. **1**.

FIG. **3** is a partially cutaway view of the seat of the chair shown in FIG. **1**, taken along line **3—3** of FIG. **1**, at an enlarged scale.

FIG. **4** is a view of a part of the frame of the back of the chair shown in FIGS. **1–3**, together with the transducer assembly, taken along line **4—4** of FIG. **2**.

FIG. **5** is a front view of a bladder useful as part of one embodiment of the invention.

FIG. **6** is a cutaway view of the bladder shown in FIG. **5**, taken along line **6—6**.

FIG. **7** is a partially cutaway view of the seat of a chair similar to the one shown in FIG. **1**, taken along line **4—4** of FIG. **1**, at an enlarged scale.

FIG. **8** is a front view of a transducer embodying the invention.

FIG. **9** is a cutaway view of the transducer shown in FIG. **8**, taken along line **9—9** of FIG. **8**.

FIG. **10** is a simplified side view of a pillow back chair embodying the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to FIG. **1** of the drawings which form a part of the disclosure herein, an apparatus **10** for applying vibrations to a portion of a human body, as included in a chair **12**, is shown. Within the seat **14** of the chair **12** is located a seat transducer assembly **20**, having a flexible, liquid-filled bladder **23** and a transducer **25**. Within the back **16** of the chair **12** is located a back transducer assembly **18** having a flexible liquid-filled bladder **22** and a transducer **24**. When a person sits in the chair, his or her back and posterior rest on covering **26**. Preferably, the covering **26** is a single thickness of cloth, leather or plastic material as is normally used to cover the cushioning foam, cotton, or other padding material of such a chair, although a layer of thermally insulative material (not shown) may also be included.

As shown in FIGS. **2** and **4**, the back **16** of chair **12** includes the back transducer assembly **18**. Stuffing **29** in the back **16** is arranged to define a cavity **28** within which the back transducer assembly **18** is located.

Adjacent and pressing directly against the rear, or inner, face of the covering **26** of the back **16** is the front face **30** of the sealed bladder **22**, which is filled with liquid and made of a flexible yet generally inelastic sheet material. The bladder **22** may be composed of any of numerous flexible materials formable into a liquid-tight container of the desired shape. Ideally the material chosen should also be inelastic so that the bladder **22** will not be deformed by stretching under the weight of a person's body. A suitable material is polyvinylchloride in sheet form having a thickness of about 20 to 24 mils. The bladder **22** is filled with a non-compressible liquid **32** such as water. Preferably, there should not be any air in the bladder **22**. While other liquids having a viscosity or consistency different from water are contemplated as suitable substitutes for water, it appears that liquids having a density similar to that of the human body perform the best.

Because the bladder **22** is oriented vertically, the weight of the liquid within the bladder may cause the bladder to tend to deform and bulge at the bottom. To counteract this tendency, narrow bridging strips **90**, shown in FIGS. **5** and **6**, may be included on the inside of the bladder **22** during its fabrication. These strips **90** are made from the same flexible, yet inelastic, material as the bladder **22** and are attached as to the inside of the bladder by using a suitable adhesive or thermal welding. The strips **90** preferably do not extend over the full width of the bladder **22** because doing so would create individual chambers within the bladder and might alter its performance.

The margin portion **34** of bladder **22** is reinforced, for example by a double thickness of the material forming the bladder **22**, to enable the attachment of suspenders **36** by fasteners such as rivets, screws or nuts and bolts **38**. The suspenders **36** are preferably strips of an elastomeric material such as polyethylene or polyvinyl chloride or a cloth-reinforced plastic. As shown in FIG. **4**, these suspenders **36** extend horizontally and vertically to keep the back transducer assembly **18** positioned in its generally vertical orientation. The suspenders **36** also serve to isolate vibrations within the back transducer

assembly **18** rather than allowing them to be transmitted to the frame **39** of the chair **12** as would happen were the back transducer assembly **18** attached to the framework **39** by an inelastic or rigid material.

If an inelastic or rigid material such as metal is used for suspenders **36**, a damper such as a rubber grommet **37** (FIG. **2**) may preferably be used between such a suspender and the chair frame **39** where connections are made, as shown in FIGS. **2** and **4**.

The margin of the back side **44** of a diaphragm **46** is adhesively attached to the front side **58** of a mounting board **52** which may be made of any of numerous rigid materials such as plywood or particle board. Although it is expected that firm, direct contact will be made between the surfaces of the back side **60** of the bladder **22** and the front side **62** of the diaphragm **46**, it is possible that a very small air pocket **56** may be formed directly opposite where the driver face **42** is firmly attached to the back side **44** of the diaphragm. If such an air pocket **56** is present, it should not greatly nor long interfere with the performance of the apparatus, because the air is soon pushed out of the air pocket **56** by operation of the apparatus.

The suspenders **36** also hold the transducer **24** in position with respect to the bladder **22** supporting the mounting board **52** with the front side **62** of the diaphragm **46** in contact with a substantial portion of the back side **60** of the bladder **22**.

The back transducer **24** operates to vibrate the bladder **22** and the liquid **32** contained in the bladder **22**. The back transducer **24** may be made from a loudspeaker such as a Pioneer B20GR30-51F-Q by modifying it. The electromagnetic driver assembly **40** and part of the metal cone support frame of the loudspeaker are used, as is shown also in FIG. **9**. Legs **48** are formed from the metal cone support frame of the modified loudspeaker to provide points of attachment **50** to the mounting board **52**. The mounting board **52** defines a centrally located hole or opening **54** extending through it. The electromagnetic driver assembly **40** is preferably centered over the opening **54** in the mounting board **52**.

The driver assembly **40** has a driver face **42** which is firmly attached to the back side **44** of diaphragm **46**, which is made of an elastic material. A rubber gasket material approximately 1/32" thick has been found to be adequate, for example, as the diaphragm **46**. Movement of the driver face **42**, which occurs in response to changes in the voltage of the electrical signal input, is generally in a forward and reverse direction as indicated by the arrow **63**. The driver face **42** is urged outwardly by the stretched diaphragm **46** and is held in a position of equilibrium that is approximately the midpoint of the thickness of the mounting board **52**. The attachment of the face **42** to diaphragm **46** is desirable because it helps keep movement of the voice coil and its foundation, such a support tube **101**, or an equivalent moving part within the electromagnetic speaker driver assembly **40**, from reaching its physical limit and bottoming out. The driver face **42** may be attached to the back side **44** of the diaphragm by a suitable adhesive, bearing in mind that the driver may move many millions of times during its life. A margin around the opening **54** on the front side **58** of the mounting board **52** has a radius **59** portion rather than a sharp edge. This radius **59** of about ½ inch has been found desirable to reduce a buzz that occurs if there is a sharp edge there.

FIG. **3** shows the seat transducer assembly **20** and seat bladder **23** located in the seat **14** of the chair **12**. The seat transducer assembly **20** and seat bladder **23** are generally similar to the back transducer assembly **18** and back bladder **22** shown in FIG. **1**, **2** and **4** and described above. Because the back transducer assembly **18** is mounted in an essentially vertical position and the seat transducer assembly **20** is mounted in an essentially horizontal position, the support structures used to mount them are one of the primary differences between them.

In order to hold the seat transducer assembly **20** and keep the front face **30** of seat bladder **23** firmly in contact with covering **26**, in the chair **12** as shown in FIG. **3**, a rigid plate **64** is mounted parallel to the seat bladder **23**. The cavity **28** is filled with suitable resilient, supportive material **31**, such as synthetic foam rubber, to support the transducer assembly **20** above the rigid plate **64**. The rigid plate **64** is supported by the bottom portion **72** of the chair, including springs **74**. A through hole **66** defined by the plate **64** accommodates a portion of the audio speaker driver **40** that extends downwardly.

A substantially airtight enclosure **68** extends downwardly from the bottom side **70** of the plate **64**. This enclosure, which may be constructed of a suitable material with sound insulative properties, is desirable to contain sound vibrations within the seat transducer assembly **20** to isolate the seat assembly from the frame of the chair **12** and minimize transmission of those vibrations downwardly from the chair into the surrounding area where the sound might disturb other people. This enclosure **68** extends into the bottom portion **72** of the chair **12** between the springs **73** of the chair seat **14**.

With reference now again to FIG. **1**, as to both back transducer assembly **18** and seat transducer assembly **20**, it is to be understood that the electromagnetic driver assemblies **40** have terminals whose positions are indicated at **75**. Attached to these terminals are lead wires **74** that carry electrical signals in the form of current that causes movement within the electromagnetic driver assembly **40**. The electrical signal supplied to the electromagnetic driver assembly **40** is preferably an audio-frequency signal in the ELF or bass range of between approximately 12 to 250 Hertz. This electrical signal could be the direct output of equipment such as an amplifier **76** amplifying signals in the audio frequency range of approximately 12–20,000 Hertz from a radio receiver, CD player, tape player, etc., or an electrical signal from such a source that is filtered by means of a graphic equalizer **78** or other well-known means to emphasize a desired frequency band.

It is also contemplated that a suitable electrical signal could be generated by means of many other devices, including pulse generators, tone generator or perhaps even amplified electronic music instruments. Difference in individuals' tastes will dictate what signal frequency and source create the most pleasing vibration, and the signals provided to the transducer assemblies **18** and **20** can be chosen to accommodate individual desires.

It is also contemplated that loudspeakers **80** could be incorporated into the back **16** of chair **12**. The loudspeakers **80** could be connected electrically through lead wires **82** to receive the unfiltered output of amplifier **76**. The listener sitting in the chair **12** would be able to enjoy hearing the full range of frequencies of music at an appropriate volume from the loudspeakers **80** while also feeling the bass vibrations in his back and posterior, as previously explained.

When an electrical signal from amplifier **76** is received by electromagnetic driver assembly **40**, the driver face **42** moves in a forward and reverse direction, as shown by arrow **63** in FIG. **2**, in response to the electrical signal. The movement of the driver face **42** causes two reactions. First, the driver face **42** causes the diaphragms **46** to move cyclicly toward and away from the respective bladders **22** or **23**, flexibly deforming them accordingly. The liquid **32** within the bladders **22** and **23** is displaced and a physical wave-like motion which can be felt is created within the bladders **22** and **23**. Second, in reaction to the force in the transducer assemblies causing the forward travel of the driver faces **42**, mounting boards **52** move slightly in a rearward direction. As each driver face **42** moves rearward in response to a change in the electrical signal, the forces that pushed the mounting board **52** rearward are relaxed and the mounting board is, instead, pushed forward against the bladder **22** or **23**, also creating movement of the liquid **32** within the bladder **22** or **23**. The above actions, occurring separately or simultaneously, create the necessary movement within bladder **22** and **23** to allow the user to feel the vibrations.

In another embodiment (not shown), the apparatus of the invention might include one or more transducer assemblies including bladders located in the mattress of a bed. Although a bed is not shown in a separate drawing, reference to FIG. **5**, which shows the horizontal placement of a seat transducer assembly **92** including a seat bladder **23**, illustrates how and where a seat bladder **23** of a seat transducer assembly **92** could be located in a bed. The mattress of the bed would correspond to the seat **14** and the box springs would correspond to the bottom frame **72**.

FIG. **7** shows another embodiment of the invention in which a seat transducer assembly **92**, similar to the seat transducer assembly **25** including a transducer **25** and a seat bladder **23**, is installed in the seat **14**. In order to hold the seat transducer assembly **92** in the desired location, with the front face **30** of seat bladder **23** firmly in contact with covering **26**, resilient supporting material **31**, such as fiber fill or foam rubber or the like, is arranged within the cavity **28** in such a manner as to support the seat transducer assembly **92** above the springs **73** and prevent it from moving. In this embodiment of the invention the plate **64** and enclosure **68** shown in FIG. **3** are not used, and the supporting material **31** expected to dampen sound from the transducer **25**. The supporting material **31** also prevents the transducer assembly **92** from moving downwardly under a person's weight.

Because the chair **12** or the seat **14** of the chair **12** may be moved or tipped over, it is desirable to keep the transducer assembly **92** in place within the seat **14** of the chair by use of elastic tie-downs **84**, as shown in FIG. **7**. The tie-downs **84** may be of an elastic cord such as a material commonly known as "shock-cord" which includes multiple, slender, parallel strands of rubber. One end of each tie-down **84** may be attached to the mounting board **52** by a connector **110** such as an eye bolt. The other ends of the tie-downs **84** may be attached to points on the inside of the seat **14**. The seat transducer assembly **92** is thus secured against lateral movement by the tie-downs **84** within the seat **14**.

FIGS. **8** and **9** show the seat transducer **25** in greater detail. The margin of the back side **44** of diaphragm **46** is adhesively attached to the front side **58** of a mounting board **52**. The driver face **42** of driver assembly **40** is adhesively attached to the central portion of the back side **44** of diaphragm **46**. This attachment causes the driver assembly to be biased and maintain a position extended away from the speaker magnet **98**. This extended position should be chosen to permit reciprocal excursion of the driver in the directions indicated by the arrow **63**, with the weight of the bladder **22** or **23** also being supported partially by the diaphragm **46**, without damaging the flexible corrugated connection **100**. A strip **108** of diaphragm material may be applied to the edge of mounting board **52** for cosmetic purposes.

The diaphragm **46**, because it is elastic, is pulled slightly inward through the opening **54** where the diaphragm **46** is attached to the driver face **42**. As mentioned previously, it is important to maintain firm, direct contact between the bladder **23** and the diaphragm **46**. Adhesive tape **106** placed across the top of the voice coil support tube **101** of the transducer driver **40** supports a quantity of epoxy material **103** filling the short cone **105** at the front of the voice coil support tube, and forming the face **42**. To eliminate the previously-mentioned potential small air pocket **56** that might result, the depression on the front face **62** of the diaphragm **46** is filled with a suitable material. It has been found that small holes **104** may be made through the diaphragm **46** and adhesive epoxy material **102** may then be poured to fill the downwardly deformed area on the front side **62** of the diaphragm **46**. The holes **104** allow the epoxy to pass through the diaphragm **46** to adhere to the driver face **42**.

It has been found that if a Pioneer B20GR30-51F-Q speaker is used for the transducer **94**, between $\frac{3}{4}$ and 1 ounce of epoxy **103** and **102** will fill the cone **105**, to form the face **42**, and also fill the depressed central area of the diaphragm **46** and create a relatively flat diaphragm surface that will mate to the bladder **23** eliminating the likelihood of any air pocket being formed. Because some epoxy **102** is also on the back side of the diaphragm **46**, the diaphragm **46** is partially encapsulated and securely adheres to the driver face **42**.

It has also been found that the mass of the epoxy **103** forming the driver face **42** and the epoxy **102** filling the depression in the diaphragm **46** result in a transducer **25** with desired acoustic characteristics. The mass of the epoxy **102**, **103** makes the transducer unresponsive to undesirable high frequencies. The low frequency vibrations, however, seem to be transmitted to the bladder with ample efficiency, thus creating enjoyable movement of the liquid with the bladder **22** or **23**.

In another embodiment of the invention, shown in FIG. **10**, a chair **86** of another style sometimes called a pillow-back chair, has layered pillows **88** suspended on the back of the chair. These pillows **88** have a structure similar to a bag and hang downwardly. A back transducer assembly **18** may be placed within one or more of these pillows. Placing and securing the back transducer assembly inside the pillow is relatively simple, such as by placing stuffing material **29**, such as fiber-fill, foam rubber or the like in the respective pillow **88** so as to surround the back transducer assembly **18** and hold it in the desired position within the pillow **88**.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that the

scope of the invention is defined and limited only by the claims which follow.

What is claimed is:

1. An apparatus for applying vibrations to a portion of a human body, comprising:

(a) at least one flexible bladder substantially full of a liquid;

(b) transducer means intimately coupled with said bladder for converting an electrical signal into a mechanical vibration and for moving a portion of said bladder in response to said electrical signal, said transducer means including an elastic diaphragm of generally planar elastic sheet material, having a front side and a rear side, said front side defining a depression filled with a solid material and said front side being in contact with said bladder, said transducer means further including means for supporting said diaphragm, and a driver having a face fixedly attached to said rear side of said diaphragm; and

(c) support means for holding said bladder and said transducer means in position to support a portion of a human body.

2. The apparatus of claim 1 wherein said diaphragm is of generally planar elastic sheet material.

3. The apparatus of claim 1 wherein said flexible bladder is composed of an inelastic material.

4. The apparatus of claim 1, further comprising filter means for modifying said electrical signal to permit the selection of a desired frequency.

5. The apparatus of claim 4 wherein said desired audio frequency is in the extremely low frequency range.

6. The apparatus of claim 1, including an audio frequency signal generator as the source of said electrical signal.

7. Apparatus for applying vibrations to a human body, comprising:

(a) a frame defining a seat and a back;

(b) a flexible bladder associated with said back and having a front face and a back side;

(c) transducer means intimately coupled with said bladder for converting an electrical signal into a mechanical vibration and for moving a portion of said bladder in response to said electrical signal, said transducer means including:

(i) an elastic diaphragm having a front side and a rear side, said front side being in contact with said bladder,

(ii) mounting board means defining an opening therethrough, for supporting said diaphragm stretched across said opening, and

(iii) a driver having a face fixedly attached to said rear side of said diaphragm;

(d) support means interconnecting said bladder with said frame, for holding said bladder in position for said front face thereof to support a portion of a human body; and

(e) flexible suspender means interconnecting said frame and said mounting board means, for supporting said transducer means in contact with said back side of said flexible bladder and isolating said frame from vibrations generated by said transducer means.

8. The apparatus of claim 7, including a second flexible bladder associated with said seat and having a front face, a second said transducer means intimately coupled with said second flexible bladder, and second support means for supporting said second transducer means beneath and supportingly in contact with said second flexible bladder.

9. The apparatus of claim 8, further including an enclosure located beneath said second transducer means for opposing transmission of vibrations downwardly from said seat.

10. The apparatus of claim 7 wherein said apparatus is a chair.

* * * * *